EVALUATION OF A NEW SCORING SYSTEM IN THE PREOPERATIVE DIAGNOSIS OF ACUTE APPENDICITIS

Dissertation submitted in

Partial fulfilment of the regulations required for the award of

M.S. DEGREE

In

GENERAL SURGERY

THE TAMILNADU

DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI

APRIL 2016

DECLARATION

I hereby declare that the dissertation entitled **"EVALUATION OF A NEW SCORING SYSTEM IN THE PREOPERATIVE DIAGNOSIS OF ACUTE APPENDICITIS"** was done by me in the Department of General Surgery at Coimbatore medical college hospital during the period from September 2014 to September 2015 under the guidance and supervision of **Prof. Dr. G. Ravindran M.S.,** Department of General Surgery, Coimbatore medical college hospital. This dissertation is submitted to the Tamilnadu Dr. M.G.R Medical University, Chennai towards partial fulfilment of requirement for the award of M.S. Degree in General Surgery. I have not submitted this dissertation on any previous occasion to any university for award of any degree.

Place:

Date: **Dr. J. Rohan Krishna**

CERTIFICATE

This is to certify that the dissertation entitled **"EVALUATION OF A NEW SCORING SYSTEM IN THE PREOPERATIVE DIAGNOSIS OF ACUTE APPENDICITIS"**is a record of bonafide work done by **Dr.J.ROHAN KRISHNA** under the guidance of **Prof.Dr.G.Ravindran M.S.,** Department of General Surgery, Coimbatore Medical College and Hospital. This is submitted for partial fulfilment of the regulations for the award of M.S. Degree in General Surgery by The Tamilnadu Dr.MGR Medical University, Chennai. This work has not previously formed the basis for the award of a degree or diploma.

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Dissertation Topic : Evaluation of a new scoring system in preoperative diagnosis of acute appendicitis

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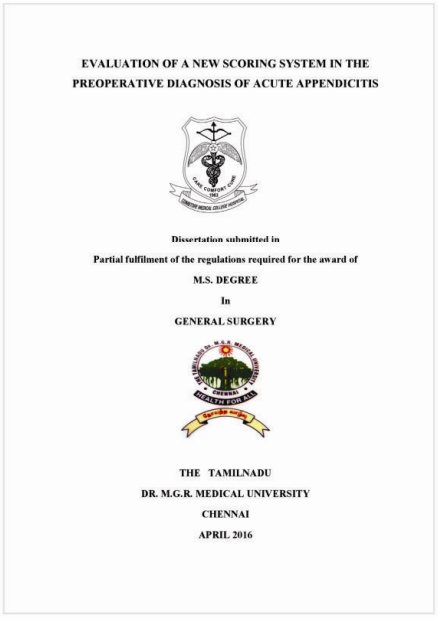

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INTRODUCTION

One of the most commonly encountered emergencies in surgical field is acute appendicitis. Men and women have a lifetime risk of 8.6% and 6.7% of developing acute appendicitis respectively[1-3]. Acute appendicitis has traditionally been a clinical diagnosis, which at times becomes difficult to diagnose due to complex presentation. Accurate and early diagnosis is of vital importance in reducing the occurrence of complications, such as appendicular perforation, appendicular abscess and phlegmon formation, which are associated with increased morbidity and mortality. Complications are more common in extremes of age (very young and very old) group of patients. They also have a greater rate of appendicular perforation with more chances of intra peritoneal spread of infection due to their poor capacity to localize[4,5].

The risk of undergoing appendectomy is 12% for men whereas for women it is 25%[1-3]. There is always the fear of perforation due to delay in diagnosis, which increases morbidity and thereafter prolongs hospital stay. On the other hand there is a high rate of negative appendectomy of about 10% to 15%[1]. This is always a cause for concern with significantly longer hospital stay, high fatality rate, higher rate of infectious complications and unnecessary hospital expenses[1]. Therefore it is of utmost importance to increase the diagnostic accuracy so as to reduce the incidence of complications.

The most accurate means of diagnosing acute appendicitis is always debatable. It has routinely been a clinical diagnosis. A combination of history, physical examination, laboratory and radiological investigations is used to accurately diagnose and treat acute appendicitis. Clinical examination has an accuracy of 70- 87% in diagnosing acute appendicitis[6-8].

The classical history of acute appendicitis is a vague periumbilical pain that localizes to the right lower quadrant, followed by anorexia, nausea, and vomiting, which evolves over 12 to 24 hours. The symptoms most consistently present are abdominal pain and anorexia[3]. Other symptoms are more variable, as are the physical findings of tachycardia, low-grade fever and the laboratory values of leukocytosis with a left shift. Tenderness to palpation, Obturator sign and Rovsing's sign are less common. Approximately 20% to 30% of patients with suspected acute appendicitis are with atypical findings[8].

Routine laboratory blood examination is mandatory but not always helpful. Both leukocytosis and raised C- reactive protein (CRP) levels are non-specific and only indicate that the patient may have some inflammation in the body. A serial rise in leukocyte count is more specific in diagnosing acute appendicitis[9,10].

Radiological investigation like X-ray of the abdomen is useful in only 8% of patients. These include presence of fecoliths, dilated sentinel loop of bowel and blurring of psoas shadows[10].

Ultrasonography (USG) has significantly improved the diagnostic accuracy in suspected appendicitis with an overall accuracy of 85-96%. The main limitation is that it is operator dependent with lower diagnostic rates with inexperienced radiologist[11,12]. Computed tomography (CT) scan has also been widely studied for the diagnosis of inflamed appendix with high accuracy of 89-98%. Limited availability and high cost limits its use in daily practice[13].

In patients with equivocal signs of acute appendicitis, diagnostic laparoscopy is very helpful in ruling out other causes of abdominal pain. In one study selective laparoscopy has reduced the rate of negative appendectomy rate from 37% to 31%; on the contrary, routine laparoscopy has reduced the negative appendectomy rate to 5%[14] .

Early and accurate diagnosis is of vital importance to reduce the morbidity and mortality and to reduce the negative appendectomies. The new scoring system[69] was formulated in an attempt to develop a scoring system with high diagnostic accuracy.

It is a combination of clinical evaluation, ultrasonography and laboratory marker of inflammatory response. Therefore this study was undertaken to find out the effectiveness of new scoring system in diagnosis of acute appendicitis. This will hopefully lower the negative appendectomy rate in our hospital.

AIMS AND OBJECTIVES

1. To evaluate the efficacy of new scoring system as a pre-operative diagnostic tool in acute appendicitis, and to correlate it with operative and histopathological findings.
2. Role of new scoring system in reducing the rate of negative appendicectomy without increasing morbidity and mortality.
3. To compare the new scoring system with other scoring systems.

REVIEW OF LITERATURE

Appendicitis refers to the inflammation of vermiform appendix. The word "vermiform" is a Latin word which means a worm shaped object. Literally speaking appendix denotes an appendage to a larger or major part as a tail or limb. The vermiform appendix is a narrow muscular tube arising from the caecum.

HISTORICAL ASPECT

Right iliac fossa pain and its consequences has been a common problem since ancient times. But it took centuries to establish appendicitis as the most important cause for this phenomenon.

- Berengarius Carpus, Professor of surgery at Pavia and Bologna gave the first description of appendix in 1522. He described a certain "addimentum" found at the end of caecum with a length of about three inches[15].
- The appendix was clearly depicted in anatomic drawings by Leonard Da Vinci and was well illustrated in the Andreas Vesalius work, "De humani corporis fabrica" published in 1543
- Fallopius in 1561 compared appendix to a worm.
- Bauhin in 1579 proposed that appendix served in intrauterine life as a receptacle for the faeces[15].

- Treves in 1888 described the possible positions of appendix in the form of clock face[16].
- Reginald H Fitz of Boston in 1866 published a review of 257 cases of perforated appendicitis describing that abscesses in the right iliac fossa were due to appendicitis and used the term “appendicitis” for the first time[15].
- James Parkinson (1775- 1824) described peritonitis as an important complication of acute perforated appendicitis[17]
- Lawson Trait in 1880 removed an inflamed but intact appendix[18].
- Claudius Amyand, F.R.S. in 1735 recorded the first removal of the human appendix during the course of operation for hernia.
- Mestivier in 1759 was the first to willfully open an appendiceal abscess.
- Hancock in 1848 performed the first deliberate laparotomy for peri-appendicular suppuration, and proposed such treatment for all cases with abscess before pointing or fluctuation had occurred.

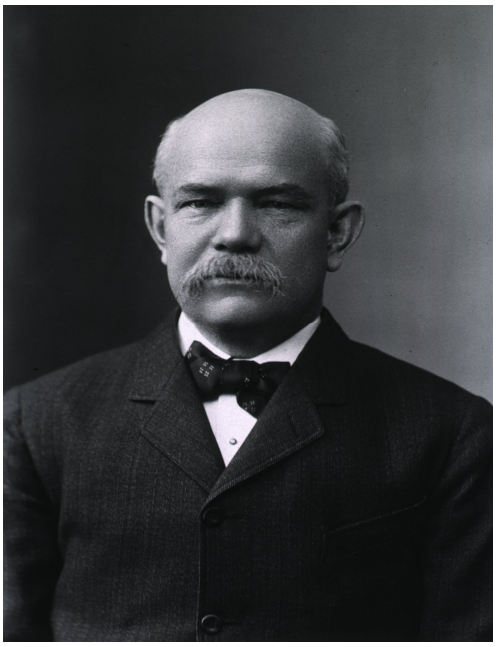


FIGURE 1

Reginald Fitz, coined the term Appendicitis in 1886

FIGURE 2

Claudius Amyand, performed first successful appendectomy

- In 1888 Treves had done the first interval appendectomy.

Since 1890 the history of appendicitis has been one of refinement in technique and diagnosis.

- Charles McBurney in 1899 described the migratory pain and demonstrated that the point of maximum palpable tenderness is determined by pressure applied by one finger (McBurney's sign) and was located "exactly between an inch and half and two inches from the anterior spinous process of the ileum on a straight line drawn from that process to the umbilicus"[20]. This point is now known as the **McBurney's point**. He also devised the muscle splitting incision for appendectomy.

- Rutherford Morrison in 1896 modified it to muscle cutting incision[21].
- Murphy in 1905 described the appropriate sequence of symptoms in acute appendicitis. It comprised of pain followed by nausea and vomiting with fever, known as Murphy's triad[22].

EPIDEMIOLOGY

- Appendicitis has greatly increased in incidence in twentieth century specifically in Europe, America and also in Australia with incidence of appendectomy approaching 16%[25].
- Incidence of appendicitis has come down dramatically in the above mentioned countries, such that individual life time risk of appendectomy is 8.6% and 6.7% respectively[26,27].
- Peak incidence of appendicitis is observed between second to fourth decades with the mean and median ages being 31.3 years and 22 years respectively.
- Before puberty both males and females have equal incidence of appendicitis after which there is a slight male: female predominance (1.4:1)
- Highest incidence in males and females is observed in the age groups 10-14 years and 15- 19 years respectively.
- Men and women have a lifetime risk of 8.6% and 6.7% of developing acute appendicitis respectively.

ANATOMY

The vermiform appendix is a muscular tube, which is narrow and contains a large amount of lymphoid tissue. It arises from the posteromedial aspect of the caecum 2 cm below the end of the ileum. The base of the appendix is easily found by identifying the taenia coli of the cecum and tracing them to the base of the appendix, where they converge to form a continuous longitudinal muscle coat. The length of appendix varies from 8 to 13 cm.

POSITIONS

Appendix may occupy any one of the several positions. The different positions of the appendix include retrocaecal, paracaecal, pelvic, subcaecal, preileal and postileal[18]. The commonest position of the appendix is the retrocaecal position comprising of 74% followed by pelvic position which accounts for 21%.

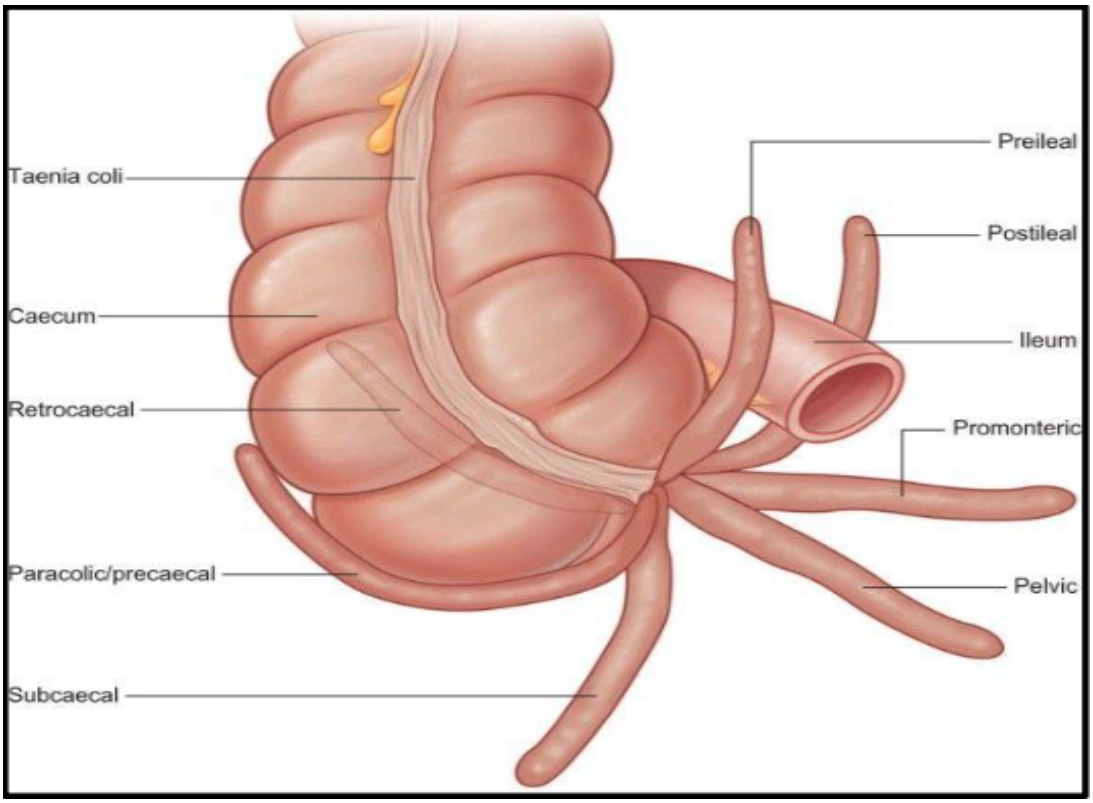


Figure 3: Diagram illustrating the different positions of the Appendix

MESENTERY OF APPENDIX

The appendix has a complete peritoneal covering, which is attached to the mesentery of the small intestine by a short mesentery of its own, the mesoappendix. Appendicular mesentery encloses blood vessels, nerves and lymphatics of vermiform appendix.

LUMEN OF THE APPENDIX

The lumen of the appendix is relatively wide in the infant and is frequently obliterated in the elderly. A valve, formed by a mucosal fold, may guard the orifice of appendix. The appendix has numerous lymphoid tissues.

HISTOLOGY

Histologically, its wall consists of four layers namely serosa, muscularis mucosa, sub mucosa and mucosa.The mucosa is lined by columnar epithelium. The lamina propria is rich in glands and lymphoid tissue which are aggregated to form lymphoid follicles that extend to the sub mucosa. These lymphoid tissues are considered as a part of mucosa associated lymphoid tissue (MALT). Muscularis propria consists of longitudinal and circular muscle layers. Except at the line of attachment of mesoappendix the appendix is completely invested by serosa[18].

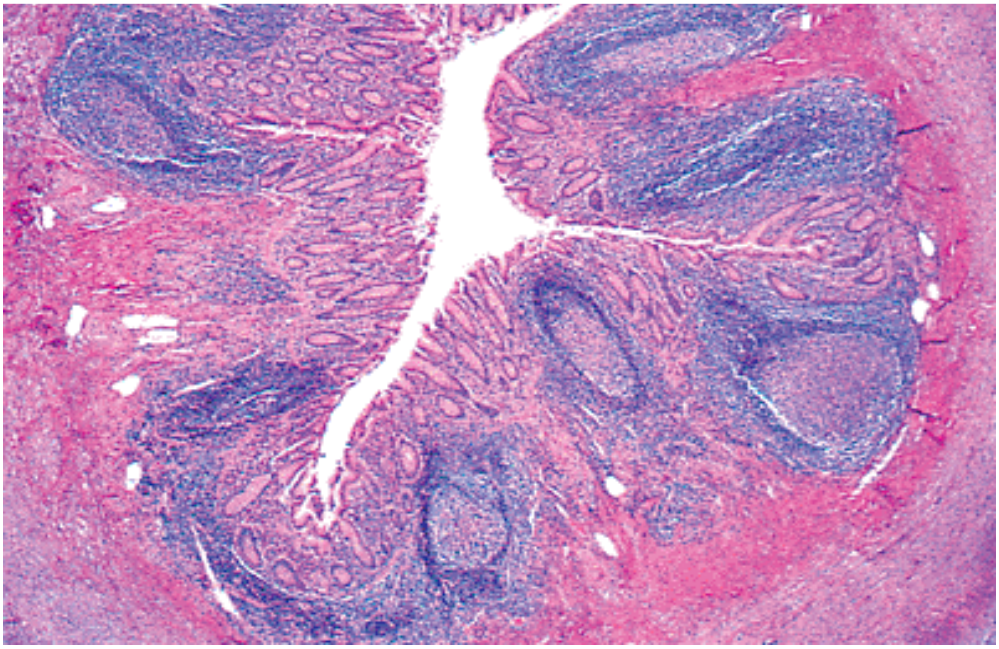


Figure 4: Histology of vermiform appendix

Surface epithelium lines the stellate lumen with characteristic lymphoid nodules present in lamina propria.

The vermiform appendix was previously thought to be a vestigial organ but now it is well recognized as an immunologic organ which actively participates in secretion of immunoglobulins particularly IgA[29].

VASCULAR SUPPLY AND LYMPHATIC DRAINAGE

ARTERIAL

The appendix is supplied by the appendicular artery, which arises from the ileocolic artery. The appendicular artery enters the mesoappendix to supply the appendix. The Accessory arteries are common, and many individuals possess two or more arteries of supply[29].

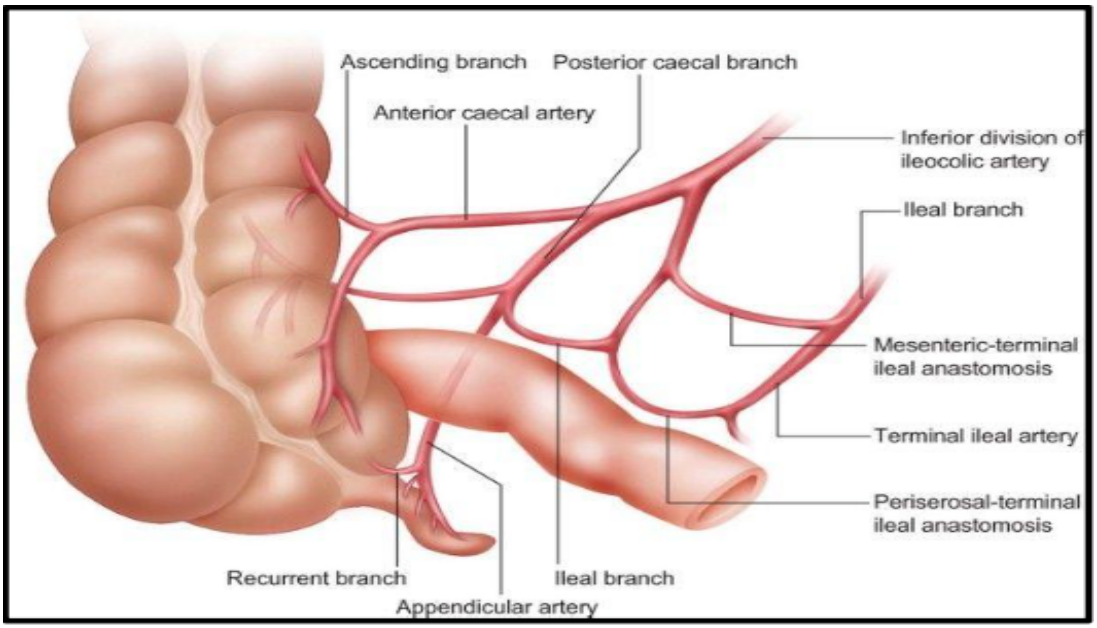


Figure 5: Arterial supply of Appendix

VENOUS

Appendicular vein is a tributary to the ileo-colic vein, which drains into the portal system[18,29].

LYMPHATICS

Appendix has abundant lymphoid tissue in its walls. From the body and apex of the appendix 8-15 vessels ascend in the mesoappendix, and are occasionally interrupted by one or more nodes. They unite to form three or four larger vessels which run into the lymphatic vessels draining the ascending colon, and end in the inferior and superior nodes of the ileocolic chain[4]and then into the superior mesenteric chain.

INNERVATION

Sympathetic: Coeliac and superior mesenteric ganglia (T11, T12)

Parasympathetic: Vagus

Both these nerves form a plexus around the artery supplying the appendix.

Visceral afferent fibers which carry sensations of distension and pressure are responsible for the pain experienced during early stages of appendicular inflammation. As the appendix is derived from the midgut, pain is referred to the central (periumbilical) region of the abdomen. It is not until parietal tissues adjacent to the appendix become involved in any

inflammatory process that somatic nociceptors are stimulated, and there is an associated change in the nature and localization of pain[29].

PATHOPHYSIOLOGY

Acute appendicitis is an inflammation of vermiform appendix. According to the pathogenesis, acute appendicitis is of two types:

1. Obstructive appendicitis
2. Catarrhal appendicitis

OBSTRUCTIVE APPENDICITIS

In obstructive appendicitis lumen of the appendix gets obstructed which is the prime initiating event. The important causes are hyperplasia of the lymphoid tissue, fecal stasis, fecoliths, parasites and rarely foreign bodies and neoplasm. Obstruction of the lumen leads to continued mucus secretion, increased intraluminal pressure, bacterial overgrowth and subsequently lymphatic, venous and then arterial occlusion. Ultimately necrosis and bacterial translocation through appendiceal wall occurs. This is typical of gangrenous appendicitis[29]. Without intervention the gangrenous appendix perforates and leads to the development of appendicular abscess, localized or generalized peritonitis according to the body's immune response to inflammation[30].

CATARRHAL APPENDICITIS

Catarrhal appendicitis is associated with inflammation of only mucosa. It is a milder form of appendicitis with less incidence of perforation and hence lesser complication rates. The inciting event responsible for initiating inflammatory response might be an infective agent, possibly of viral origin[21]. Initially the appendix appears normal or hyperemic, but the mucosa is thickened, edematous, and reddened. As the disease progresses it may become dark and brownish with hemorrhagic infarct and patches of ulcers. Subsequently the appendix is swollen, turgid and serosa becomes roughly coated with exudates. Because lumen of appendix is not obstructed, it rarely progresses to gangrene. In most of the cases it resolves spontaneously. Due to repeated attacks the appendix may be kinked and may develop into obstructive appendicitis due to local adhesion[21,30].

BACTERIOLOGY

The flora of the inflamed appendix differs from that of the normal appendix which has variety of aerobic as well as anaerobic bacteria. **Escherichia coli** is the commonest aerobic bacteria and **Bacteroides fragilis** is the most common anaerobic bacteria implicated. Other bacteria isolated are Klebsiella spp., Proteus spp., Streptococcus faecalis, and Clostridium perfringens[29] .Among patients with an acute non perforated appendicitis, cultures of peritoneal fluid are frequently negative and are of limited use[31].

Among patients with perforated appendicitis peritoneal fluid cultures are more likely to be positive, revealing colonic bacteria with predictable sensitivities[29].

CLINICAL MANIFESTATION

Acute appendicitis is predominantly a clinical diagnosis based on history and physical findings aided by laboratory and radiological investigations. The accuracy rate of the clinical diagnosis of acute appendicitis has been reported to be approximately 70% to 87%[18,19].

SYMPTOMS

1. Pain

Patients with acute appendicitis typically present with pain in epigastrium or periumbilical region which later shifts to the right iliac fossa. As the segmental supply of appendix corresponds to that of the umbilicus the pain is referred to the umbilicus. When the disease process progresses, it leads to transmural inflammation which leads to involvement of parietal peritoneum. At this stage patient has a localized right iliac fossa pain which is somatic pain.

2. Anorexia, Nausea &Vomiting

Pain is followed by anorexia and nausea.Vomiting may develop at this time.Anorexia is one of the most constant symptoms of appendicitis and hence the diagnosis of appendicitis should be questioned in a hungry patient[20].

3. Fever

Fever is not present early in the course of illness. A low grade fever can be present in simple appendicitis; however high grade fever after the onset of illness points towards complicated appendicitis like perforation or abscess formation[33].

4. Bowel disturbance

Patients with acute appendicitis may present with constipation due to adynamic ileus. Some patients may also present with diarrhea. Diarrhea can occur in pre or post-ileal positions of appendix, due to irritation of the distal ileum.

Signs

Tenderness in the right iliac fossa (RIF) is an important sign in acute appendicitis. It is present in more than 90% of the patients. Classically, the area of maximum tenderness will be at McBurney's point. However, tenderness is non specific, and may be absent early in the course of the

disease. The degree and point of tenderness may vary according to the position of the appendix with lesser degree of tenderness in retrocaecal appendix. In pelvic appendix there may not be abdominal tenderness, but tenderness in the right wall of the rectum on rectal examination. Presence of rebound tenderness in the right iliac fossa indicates inflammation of the parietal peritoneum and is thought to have sensitivity of 63% and specificity of 69% in diagnosis of acute appendicitis[33].

Demonstration of localized muscular guarding and rigidity (sensitivity 39-74%, specificity 57-84%) indicates more severe degree of inflammation and also localized peritonitis as a result of perforation[32,20].

Rovsing's sign is positive when patient experiences pain in the right iliac fossa upon application of pressure in the left lower abdomen (sensitivity 16%, specificity 58%)[33].

Psoas sign (sensitivity 16%, specificity 95%) is an indicator of retrocaecal appendicitis, overlying the psoas major muscle. Pain is elicited by extending the right hip with knee in full extension.

Obturator sign[20] is positive in pelvic appendicitis where pain is elicited upon internal rotation of right leg with hip and knee flexed. Positive sign indicates that the inflamed appendix is lying above the obturator internus muscle in pelvic position.

Dunphy'sign (right lower abdomen pain on coughing)[33] indicates localized peritoneal inflammation.

Patients who present late with generalized abdominal pain, generalized tenderness and rigidity with initial features of acute appendicitis points towards appendicular perforation peritonitis.

Low grade fever is common.If the appendix perforates temperature rises above 39 degree centigrade.

DIAGNOSIS OF ACUTE APPENDICITIS

Though many clinical and lab parameters have been described, early and accurate diagnosis of acute appendicitis at times becomes difficult. Delayed diagnosis and delayed intervention increased morbidity and mortality. The mortality rate in non perforated appendicitis is less than 1%, but it may be as high as 5% or more in young and elderly patients[34]. Clinical history and physical examination remain the most important modality of assessment. Additional information is provided by laboratory and radiological studies and hence the combination of all of these increases the overall diagnostic accuracy of acute appendicitis. The diagnostic value of different lab parameters appeared to be dependent on the degree of inflammation and perforation[35].

DIAGNOSTIC HEMATOLOGICAL INVESTIGATIONS

Total Leucocyte Count (TLC)

- Total Leucocytes Count is an important marker of inflammation. Approximately 79-90% of patients with acute appendicitis have a raised TLC[36,37].
- The sequential rise in TLC has a better diagnostic accuracy than a single high count (sensitivity 92 vs. 69% and specificity 100 vs. 83%) as elevated TLC has low specificity[41].
- Up to 60% of patients with only non-specific abdominal pain can have increased counts initially[39]. When the counts are repeated after some time either it remains persistently high or increases further in patients with acute appendicitis, but decreases significantly in patients with non specific abdominal pain[40] (mainly non-inflammatory).
- Some reports indicate that high TLC with differential count showing neutrophilia is a reliable indicator of the severity of acute appendicitis and signifies a more advanced stage[42,43], whereas others find it a very poor predictor of severity of the disease[44].

- The rate of infection increases as the total counts rises above the upper normal limit indicating that the raised counts also has some prognostic value[45].
- The percentage of neutrophils is also important in diagnosing appendicitis. More than 78% of the patients with acute appendicitis have various degrees of neutrophilia[46] .

C- reactive protein (CRP)

- C-reactive protein is one of the acute phase proteins.
- Any bacterial infection induces the synthesis of CRP and its elevation indicates ongoing inflammation in the body.
- CRP level rises within 4-6 hours in response to bacterial infections reaching peak value at 36-50 hours.
- CRP level becomes normal in 3-7 days following withdrawal of stimulus.
- Physiologically, CRP enhances cell-mediated immunity by promoting phagocytosis, accelerating chemotaxis, and activating platelets.
- It's a non specific marker of inflammation.

- Extensive studies have been done to establish the role of raised CRP levels in diagnosing acute appendicitis[38,47].
- The diagnostic accuracy of CRP has shown a wide range of variations in different studies with sensitivity of 40-99% and specificity 27-90%[48,49].
- The level of circulating CRP correlates with the severity of appendicitis[41,37].
- Nearly 71-75% of patients who presented with early appendicitis had elevated CRP levels and whereas in patients with gangrenous appendicitis it was about 83-90%[41].
- High level of CRP (>0.8 mg/dl) with leukocytosis and neutrophilia are the most common lab findings in acute appendicitis[50].
- The type of bacterial infection cannot be ascertained from CRP results.

Other markers of inflammation

Interleukin-6 (IL-6), tumor necrosis factor α (TNF-α) and acid α1-glycoprotein (α1 GP), are some of the other inflammatory markers tested in acute appendicitis. In one study the IL-6 was found to be superior to CRP and TLC in predicting acute appendicitis, with sensitivity of 84%, specificity of 79% and diagnostic accuracy of 82%[51].

Urine Analysis

- Urinalysis is commonly performed in patients with lower abdominal pain to rule out urinary tract pathology.
- It's not helpful for confirming the diagnosis of acute appendicitis.
- Hematuria, pyuria and proteinuria can be present in 40% of patients with acute appendicitis[53].
- In cases of retrocaecal appendicitis irritation of bladder or ureter may result in pyuria.
- Presence of urinary symptoms or abnormal findings in urinalysis does not rule out acute appendicitis.

RADIOLOGICAL STUDIES

Plain abdominal X-ray

There is no pathognomonic sign of appendicitis in x-ray examination. Plain films may show a faecolith at the appendicular region. A distended loop of small bowel in the right lower quadrant may be seen. Rarely a distended caecum or a gas-filled appendix may be detected. In late complicated acute appendicitis straight x-ray may reveal absence of small bowel gas in the right lower quadrant.

Barium contrast studies

Radiological signs of acute appendicitis after barium enema[55] are:

- Persistent non-visualization of appendix (5-10% normal appendices cannot be visualized).
- Partial visualization.
- Pressure effects on the caecum.
- Irritability of the caecum or ileum as seen by fluoroscopy.

Barium enema is no longer done today for diagnosis of Acute Appendicitis because of invasiveness of the test, the time required to perform the tests, low diagnostic yield, attendant complications and the need for special preparation and the availability of high resolution USG and CT scan. Barium enema complements USG and CT examinations in defining mucosal lesions of the caecum and appendix. It should be considered in settings of chronic or recurrent abdominal pain. It can be used for Acute Appendicitis when diagnosis is suspected but unclear and when both CT and USG are not helpful.

Ultrasonography (USG)

Abdominal USG and computed tomography are the most commonly used imaging tests in evaluation of acute appendicitis. USG is done using linear array transducers (usually 5-MHz).

Positive USG criteria include a

- Non-compressible appendix with an anteroposterior diameter of 7mm or greater.
- Presence of periappendicular fluid
- Disruption of echogenic continuity of sub mucosa
- Appendicolith
- Atypical target sign[57].

In cases of perforated appendicitis sensitivity of ultrasound is low due to abdominal wall rigidity, which prevents adequate compression. Recent developments in the technique and interpretation of USG have made this a valuable adjunct to physical examination especially in young women and in patients with atypical symptoms. USG has significantly improved the diagnostic accuracy in suspected appendicitis with an overall accuracy of 85-96%[59,60]. For differential diagnosis of acute appendicitis, USG demonstrates other diseases that mimic Acute Appendicitis.

By ruling out other causes of right iliac fossa pain (e.g. mesenteric lymphadenitis or terminal ileitis in children and gynecological causes in young women) it is possible to reduce the negative appendectomy rate.

Advantages of USG are

- ✓ It is noninvasive
- ✓ Free of radiation hazards
- ✓ Can be performed quickly
- ✓ Can identify and rule out other conditions producing abdominal pain.

Disadvantages of USG are

- ✓ Requires technical expertise
- ✓ It is operator dependent.

Computed Tomography (CT)

- With the growing availability and resolution, contrast-enhanced computed tomography (CECT), is a very accurate tool in diagnosing acute appendicitis.

- CECT, oral and intravenous contrast-enhanced is used for the highest diagnostic accuracy.

- Improved imaging techniques including use of fine (5mm) cuts images have resulted in increased accuracy of CT scans.

- A CT scan is read as positive for acute appendicitis if one or more of the following feature are identified: inflamed pericaecal fat, an irregular semi liquid fluid-filled pericaecal lesion with or without the presence of a gas bubble, the visualization of a fecolith, or a distended appendix (≥7 mm in diameter)[57].

- CT scan has accuracy of 89-98%[50].

- CT scan is more sensitive and accurate compared to other imaging modalities, non invasive and also identifies other pathologies.

- Disadvantages of CT scan are its limited availability, high cost, exposure to radiation and risk of anaphylactic reactions due to usage of intravenous contrast agent.

Magnetic Resonance Imaging (MRI)

- MRI is an emerging promising technique for the diagnosis of Acute Appendicitis.
- It is especially useful in patients with non diagnostic ultrasound and in patients where radiation is a clinical concern, such as pregnant and pediatric patients[63].
- MRI is most useful for evaluating pregnant patients with acute lower abdominal pain believed to have an extra-uterine cause, such as appendicitis or ovarian torsion.
- The accuracy of MRI was assessed in a retrospective study comprising of 51 pregnant patients who were suspected to have appendicitis but had no significant findings in ultrasonography.
- MRI had a sensitivity of 100% and specificity of 93.6%.
- Positive predictive value of MRI was 91.4% whereas negative predictive value was 100%[64].
- Disadvantage of MRI include its high cost, the limited availability of MRI system and trained radiologists.

Nuclear medicine

- Radionuclide scanning has been studied in patients with suspected Acute Appendicitis with atypical features.
- The test is based on the localization of technetium-99m labeled leukocyte and IgG at the site of inflammation[57].Technetium-99m albumin labeled neutrophils and macrophages are administrated intravenously and serial images of abdomen and pelvis are obtained over 4 hrs.
- Appendiceal inflammation is characterized by uptake of tracer in the right lower quadrant (RLQ).
- The sensitivity and specificity of this test ranges between 80-90% and 92-100% respectively[64,65].
- Using newer labeling techniques sensitivity has approached 98% in patients with appendicitis[66,67].
- It may be potentially useful in patients with persistent symptoms and negative radiological findings[57].
- Lack of availability and acquisition time of 5 hours is its disadvantages.

Diagnostic Laparoscopy

It is useful when the diagnosis of appendicitis is unclear[57]. Laparoscopy provides the surgeon with the tool to rule out appendicitis and then inspect other organs to determine the real cause of symptoms. In patients with equivocal signs of acute appendicitis, diagnostic laparoscopy is very helpful in ruling out other causes of abdominal pain.In one study selective laparoscopy has reduced the rate of negative appendectomy rate from 37% to 31% by contrast; routine laparoscopy has reduced the negative appendicectomy rate to 5%[28]. Its unavailability, invasiveness and the need for the expertise are its limitations in our context.

Differential Diagnosis of Acute Appendicitis

The differential diagnosis of AA is often a clinical challenge because appendicitis can mimic several acute abdominal conditions. The differential diagnosis of acute appendicitis include Meckel's diverticulitis, typhilitis, omental torsion, psoas abscess, ureteric colic, gastroenteritis, enterocolitis, diverticulitis, perforated duodenal ulcer, acute pancreatitis, acute cholecystitis, biliary colic and UTI. Small bowel obstruction, Crohn's disease, carcinoma of caecum or ascending colon are some of the rare conditions which can mimic acute appendicitis.

In children mesenteric lymphadenitis, intussusception and Henoch-Schonlein purpura, should also be considered.

CLINICAL OUTCOME OF APPENDICITIS

- Resolution
- Gangrenous appendicitis
- Perforation leading to generalized peritonitis
- Appendicular mass or abscess formation
- Fibrosis

MANAGEMENT

Immediate appendicectomy is the treatment of choice in acute appendicitis. Immediate appendicectomy should be performed to obviate possibility of complications.

PRE-OPERATIVE

Clinical examination, laboratory investigations and radiological examination is followed by the below measures:

- Patient is kept nil orally
- Parenteral fluid therapy to maintain fluid and electrolyte balance
- Analgesics to relieve pain and reduce anxiety
- Preparing the abdomen for emergency laparotomy.

OPERATIVE PROCEDURE

INCISIONS FOR APPENDICECTOMY

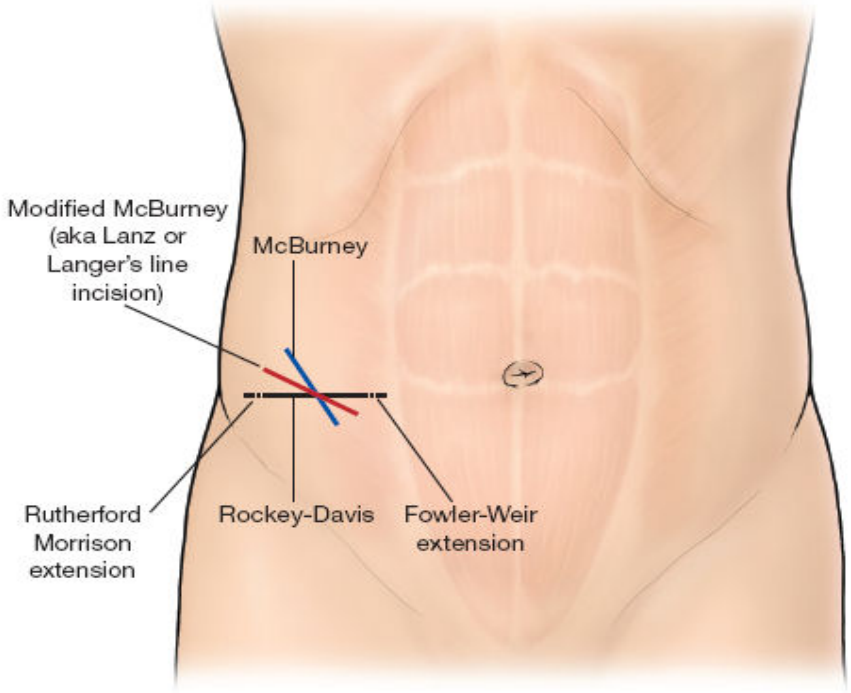


Figure 6: Incisions for open appendectomy

a) Grid-iron incision:

This is an oblique incision through the McBurney's point perpendicular to the spinoumbilical line at its junction between lateral one-third and medial two-thirds.

b) Lanz's incision:

This transverse incision is made at a level 2 to 3 cm below the umbilicus and is centered on the midclavicular- midinguinal line.

ADVANTAGE- This incision lies in the direction of Langer's lines and is better cosmetically than the McBurney's incision.

DISADVANTAGE- The rectal sheath is opened at the medial end of the wound.

c) Rocky-Davis incision:

It is a muscle splitting right lower quadrant incision for appendectomy. Incision is placed transversely between the junction of the lower and middle third of a line from anterior superior iliac spine to umbilicus. The aponeurotic and muscle layers are opened similar to Mcburney's incision. Unlike the McBurney incision, it is a straight transverse incision.Medial extension over the rectus muscle is known as Fowler-Weir extension whereas lateral extension through the muscle bellies of the internal oblique and transverses abdominis is called Rutherford-Morrison incision.

APPENDICECTOMY PROCEDURE

Anaesthesia

General or Spinal anaesthesia can be administered.

After incising the skin, fascia of Camper and fascia of Scarpa are divided along the line of incision. External oblique aponeurosis is split along the line of fibers and retracted. The muscle fibers of internal oblique and the fibers of the transverses abdominis are separated by inserting the tip of the artery forceps and opening it. The fingers are now introduced and these muscle fibers are retracted to expose the peritoneum. The peritoneum is picked up by two artery forceps and incised to enter the abdominal cavity.

After opening the peritoneal cavity, two fingers are introduced to get hold of the caecum. Coils of ileum, which has got no taenia coli, is taken out. Caecum is best withdrawn by following the peritoneum on the lateral side of the abdomen and it reaches the caecum which is relatively fixed because the ascending colon has got no peritoneum in its posterior surface. The caecum is relatively whitish, has taenia coli and no omentum and mesocolon. It is taken out of the abdomen with the aid of a pair of Babcock's tissue forceps. Now the anterior taenia coli is followed downwards to reach the vermiform appendix.

All other portions of bowel are reinserted into the abdominal cavity except the caecum and the appendix. A pair of tissue forceps is applied to the tip of the mesoappendix. The appendix is lifted up using the tissue forceps.

Figure 7: Inflammed appendix with thickened mesoappendix

The mesoappendix is pierced in the avascular segment at its base with a mosquito artery forceps and the appendicular artery is secured with a ligature through this hole. The mesoappendix is now divided close to the appendix till the caecum is reached.

The base of the appendix is crushed with a pair of strong artery forceps. By this process only the mucous and the muscular coats are crushed and curled inwards to occlude the lumen but the peritoneal coat remains unaffected. A ligature is tied around the crushed area. A pair of artery forceps is applied to the appendix 5 mm distal to the ligature. A swab is placed beneath the base of the appendix and the appendix is divided close to the forceps and removed. Abdominal wound is closed in layers.

LAPAROSCOPIC APPENDICECTOMY

Laparoscopic appendectomy was first performed in 1983 by Semm.

ANAESTHESIA

Laparoscopic appendectomy is performed under general anesthesia.

PREPARATION

An oro- or nasogastric tube is inserted and patient is catheterized. The patient is placed supine with his or her left arm tucked and securely strapped to the operating table. With the surgeon and assistant standing on the patient's left, the laparoscopic screen is positioned on the patient's right or at the foot of the bed.

TECHNIQUE

Standard laparoscopic appendectomy is performed using three port technique. A 10- or 12-mm port is placed at the umbilicus, and two 5-mm ports are placed suprapubic and in the left lower quadrant. The patient is placed in Trendelenburg and tilted to the left.

PROCEDURE

The appendix is identified similarly by tracking the taeniacoli to the appendiceal base. Through the suprapubic port, the appendix is grasped securely and elevated to the 10 o'clock position.

An "appendiceal critical view" is obtained with the taenia libera at the 3 o'clock position, the terminal ileum at the 6 o'clock position, and the retracted appendix at the 10 o'clock position to allow proper identification of the base of the appendix. Through the infraumbilical port, the mesentery is gently dissected from the base of the appendix and a window created. The base of the appendix is stapled, followed by stapling of the mesentery. Alternatively, the mesentery may be divided by an energy device or clipped and the base of the appendix secured with an Endoloop. The stump is carefully examined to ensure hemostasis, complete transection, and ensure that no stump is left behind. The appendix is removed through the infraumbilical trocar in a retrieval bag.

POST-OPERATIVE MANAGEMENT

- Oral feeds are withheld till the bowel sounds return and flatus is passed.
- IV fluids and electrolytes are given till oral feeds are allowed.
- Broad-spectrum antibiotics are given to cover against mixed intestinal flora, till culture report of the peritoneal exudate is obtained.
- TPR chart is maintained.
- Analgesics and sedatives.
- Drain if placed in the peritoneal cavity, is removed by 24-48 hrs.
- Sutures removed by 7-10 days.

COMPLICATIONS OF APPENDICECTOMY

Most of the complications are not peculiar to appendicectomy, but occur with any abdominal surgery.

Early Complications

- Hemorrhage
- Diffuse peritonitis
- Pulmonary complications
- Neurogenic or adhesive ileus
- Retention of urine

Intermediate Complications

- Secondary or residual abscess (Pelvic/paracaecal)
- Wound infection: the commonest, especially in a complicated appendicitis
- Femoral or Iliac vein thrombosis
- Persistent sinus or fistula
- Rupture of caecal wall

Late Complications

- Incisional hernia
- Right sided indirect inguinal hernia
- Intestinal obstruction

Treatment of complications should be done as and when it occurs, by early recognition and skillful surgical intervention or conservatively if required.

SCORING SYSTEMS

Early diagnosis and prompt treatment is very important to reduce the incidence of complications especially in children and older individuals. Acute appendicitis is mainly a clinical diagnosis and there are no laboratory or imaging studies to diagnose it with 100% accuracy.

Lots of effort has been made to diagnose and treat acute appendicitis as early as possible. Many scoring systems were formulated to diagnose appendicitis early. Scoring systems are very helpful in distinguishing between acute appendicitis and other conditions causing abdominal pain[68].

During the last 20 yrs there has been a growing trend towards the use of formal reasoning or quantitative data as a guide to clinical decision making[63]. In this respect, several scoring systems, computer based models, and algorithms[70,71] have been developed for supporting the diagnosis of Acute Appendicitis on the basis of medical history, clinical symptoms and signs, and indicators of inflammatory response. The main aim of these scoring systems is to precisely diagnose acute appendicitis ruling out other possibilities. Alvarado scoring system is the most popularly used system of evaluation all over the world.

Alvarado scoring system

Alvarado formulated Alvarado scoring system[72] in 1986. This system is based on clinical evaluation and lab markers of inflammatory response and has been validated in adult surgical practice. There are all together 8 parameters with a total score of 10 and a score of 7 or more is considered as diagnostic of Acute Appendicitis and needs immediate operative management[73]. With the score of less than seven, patients are observed and reevaluated to rule out other causes of right iliac fossa pain. The reported sensitivity and specificity of Alvarado score ranges from 73-90% and 87-92% respectively[74,75].

TABLE 1 : THE ALVARADO SCORE

SYMPTOM (MANTRELS)	**SCORE**
1.**M**igratory RIF Pain	1
2.**A**norexia	1
3.**N**ausea & Vomiting	1
SIGN	
1.**T**enderness Over RIF	2
2.**R**ebound Tenderness RIF	1
3.**E**levated Temperature	1
LAB FINDINGS	
1.**L**eucocytosis	2
2.**S**hift To Left	1
TOTAL	10

- Patients with scores of 7-10: Probably Appendicitis.
- Patients with scores of 5-6: May be Appendicitis
- Patients with scores of 1-4: Unlikely to be Appendicitis

Modified Alvarado scoring system

The classic Alvarado score included left shift of neutrophil maturation (score 1) yielding a total score of 10. However in 1994 Kalan omitted this parameter and produced a modified score. Patients with score of 7 or above have high probability of having acute appendicitis[76].

TABLE 2:THE MODIFIED ALVARADO SCORE

SYMPTOM	**SCORE**
1.Migratory RIF Pain	1
2.Anorexia	1
3.Nausea &Vomiting	1
SIGN	
1**.**Tenderness IN RIF	2
2.Rebound Tenderness	1
3**.**Elevated Temperature	1
4.Extra sign(s) e.g. cough test and /or Rovsing's sign and/or rectal tenderness	1
LAB FINDINGS	
1**.**Leucocytosis	2
TOTAL	10

Interpretation of the Modified Alvarado score is as follows:

- Score 8-10: acute appendicitis definite
- Score 5-7: acute appendicitis probable
- Score 1-4: acute appendicitis very unlikely

In the diagnosis of acute appendicitis, the modified Alvarado score is a fast, simple, reliable, noninvasive, repeatable and safe diagnostic modality without extra expense and complications. It is very handy in peripheral hospitals where backup facilities are sparse. The application of this scoring system improves diagnostic accuracy and consequently reduces negative appendicectomy. Early intervention based on this assessment reduces complication rates. Talukder DB et al[77] found that sensitivity increases as the score becomes higher. Accuracy of Alvarado is as follows

SCORE	ACCURACY
8-10	95%
5-7	78%
1-4	0%

According to Fengo et al[78] the results are as follows

	Males	Females
Sensitivity (Score > 7)	93%	84%
Sensitivity (Score < 7)	73%	60%

Several other scoring systems have been developed and include Fenyo, Lindberg, Izbicki, Ohmann, Van Way, Teicher, De Dombal, Christian which are based on clinical, laboratory and radiological investigations.

NEW SYSTEM OF SCORING

This scoring system was formulated to develop a scoring system with high diagnostic accuracy[69] with limited parameters. It was developed by Nikolas E.Tzanakis and colleages in 2004. This score is a combination of the clinical evaluation, USG and lab marker of inflammatory response. There are altogether 4 variables and 15 points and a score of 8 or more is taken as a cutoff value for the diagnosis of acute appendicitis and the patient needs surgery. Patient with a score below 8 have less chances having acute appendicitis[69].This scoring system has the sensitivity, specificity and accuracy of 95.4%, 97.4% and 96.5% respectively[69].

TABLE 3: THE NEW SCORE

Variables	Points
Positive USG for acute appendicitis	6
Tenderness in right lower quadrant	4
Rebound tenderness	3
Leukocyte count>12000/ul	2
Total score	15

- Score of 8 and above : acute appendicitis definite
- Score below 8: acute appendicitis unlikely

METHODOLOGY

SOURCE OF DATA:

- 100 patients presenting with pain abdomen, diagnosed provisionally as acute appendicitis and undergoing surgery in the Department of General Surgery at Coimbatore Medical College and Hospital.

STUDY PLACE:

- Coimbatore Medical College and Hospital

STUDY DESIGN:

- Prospective Observational Study

SAMPLE SIZE:

- 100 Patients

STUDY PERIOD:

- SEPTEMBER 2014 – SEPTEMBER 2015

INCLUSION CRITERIA

- Patients with clinical diagnosis of acute appendicitis and undergoing surgery and willing to participate in study.

EXCLUSION CRITERIA

- Patients with generalized peritonitis
- Patients with appendicular abscess
- Patients with appendicular lump
- Patients with blunt trauma abdomen
- Patients who have undergone GI surgeries in the past

100 patients admitted in General surgery department in Coimbatore Medical College suspected clinically to have acute appendicitis were studied.

- A detailed clinical history was taken for all the patients. Thorough physical examination was done for all the patients.
- Patients were evaluated preoperatively with hematological and radiological investigations (Ultrasound of abdomen and pelvis)
- The diagnosis of acute appendicitis was done on the basis of clinical judgement and patients were taken up for surgery.

Simultaneously new scoring is also recorded. Histological reports are followed up and recorded in the preformed Proforma sheet. The final diagnosis of acute appendicitis is based on histological diagnosis.

RESULTS

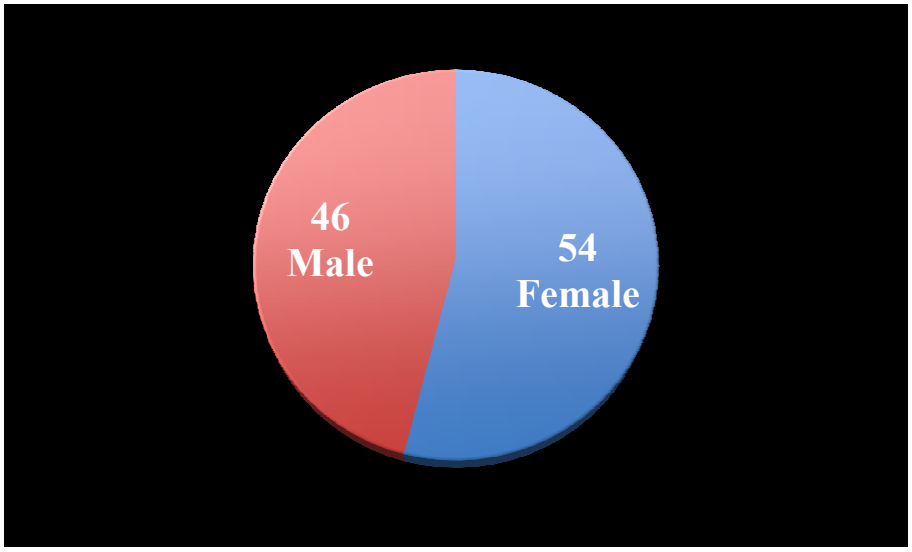
SEX DISTRIBUTION

Our study population consists of 100 cases in total. Total number of male cases is 54 whereas total number of female cases is 46.

TABLE 4: SEX DISTRIBUTION OF STUDY

Sex	Number	Percentage
Male	54	54%
Female	46	46%

CHART 1: SEX DISTRIBUTION OF STUDY POPULATION



AGE DISTRIBUTION

- Out of the study population of 100 patients, minimum age was 14 years whereas the maximum age was 52 years.
- The numbers of patients were highest in the age group 21-30 years (45%) followed by 10-20 years (35%).
- The least number of patients were in the age group above 50 years.

TABLE 5: MEAN AGE OF STUDY POPULATION

	N	Minimum	Maximum	Mean	Standard deviation
Mean age	100	14	52	25.43	7.30

TABLE 6: AGE DISTRIBUTION OF STUDY POPULATION

Age in years	Number	Percentage
10-20	35	35%
21-30	45	45%
31-40	16	16%
41-50	3	3%
51-60	1	1%
Total	**100**	**100%**

CHART 2: AGE DISTRIBUTION OF STUDY POPULATION

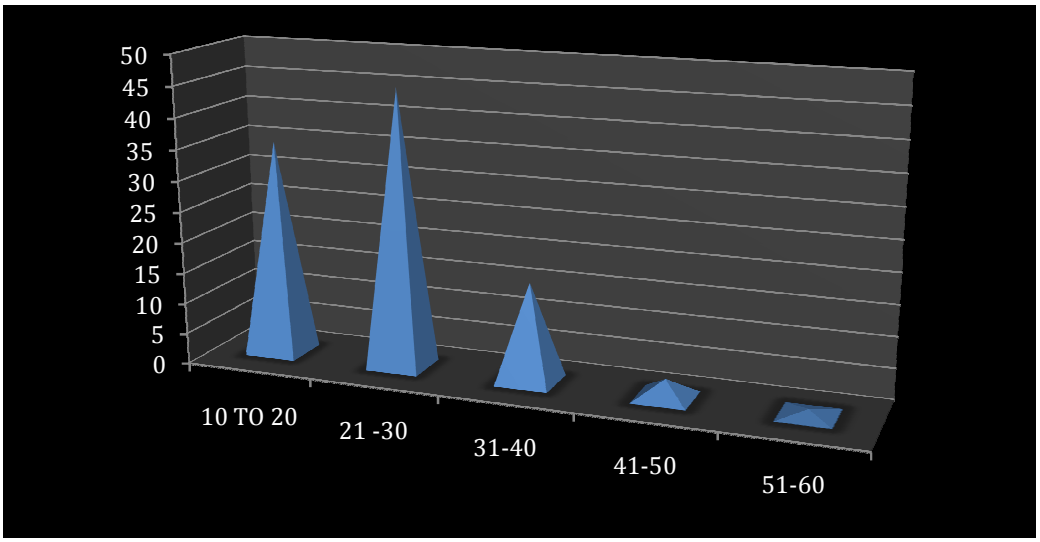


TABLE 7: AGE AND SEX DISTRIBUTION OF STUDY POPULATION WITH PERCENTAGES

Age in years	Male	Female
10-20	20(57.1%)	15(42.9%)
21-30	25(55.6%)	20(44.4%)
31-40	7(43.8%)	9(56.3%)
41-50	2(66.7%)	1(33.3%)
51-60	0(0%)	1(33.3%)
Total	**54(54%)**	**46(46%)**

CHART 3: AGE AND SEX DISTRIBUTION OF STUDY POPULATION

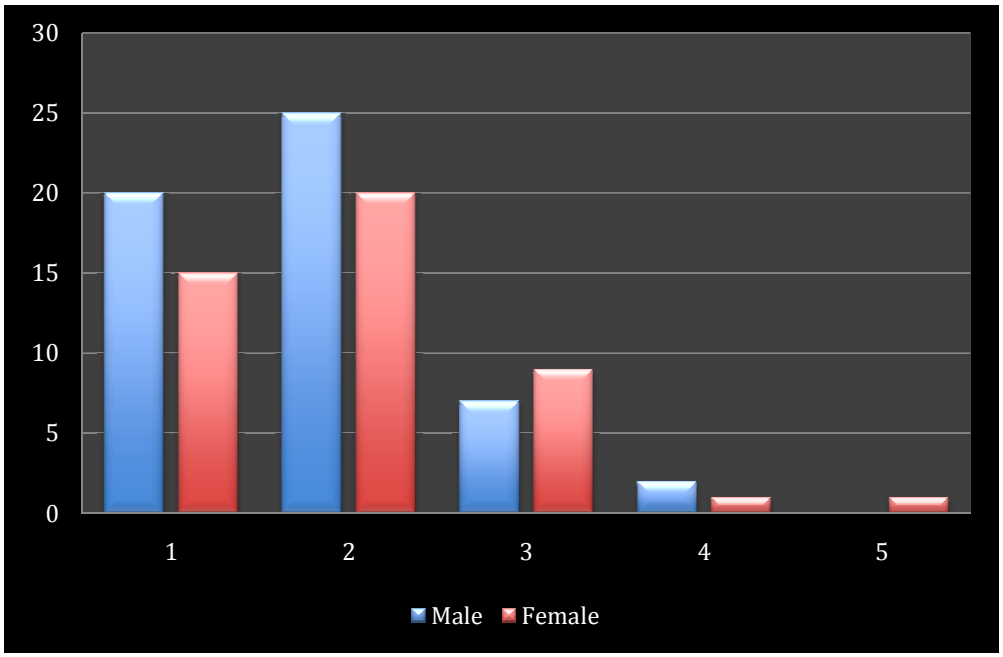


TABLE 8: INDIVIDUAL FEATURES OF THE NEW SCORING SYSTEM

Variables	Number	Percentage
USG positivity	58	58%
RLQ Tenderness	100	100%
Rebound tenderness	72	72%
Leukocyte count>12000/ul	51	51%

Among the 4 variables of the new scoring system, right lower quadrant tenderness was present in all cases (100%), rebound tenderness was seen in 72% cases, USG findings were positive in 58% and leukocytosis was seen in 51% cases.

Patient distribution according to the new score

Out of 100 patients, 22% had New score between 4 and 6, 20% had New score between 7 and 9, 22% had New score between 4 and 6 while 43% had score more than 13.

TABLE 9: PATIENT DISTRIBUTION ACCORDING TO THE NEW SCORE

Score	Frequency	Percentage
0-3	0	0
4-6	22	22
7-9	20	20
10-12	15	15
13-15	43	43
TOTAL	**100**	**100**

CHART 4: SCORE WISE DISTRIBUTION OF CASES

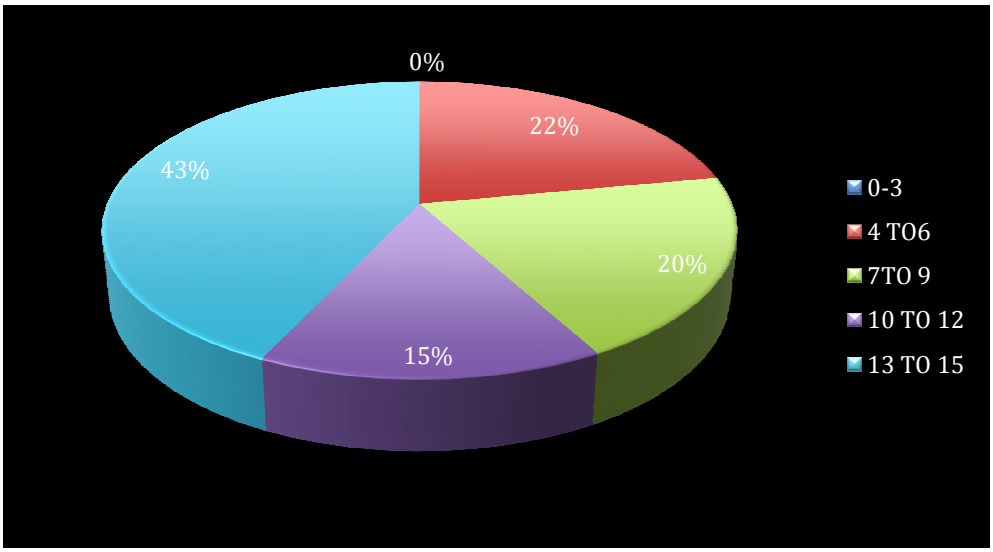


TABLE 10: DISTRIBUTION OF STUDY POPULATION ACCORDING TO NEW SCORE

In our study population 75 patients had scores more 8 while 25 patients had scores less than 8.

Score	Number	Percentage
≥8	75	75%
<8	25	25%

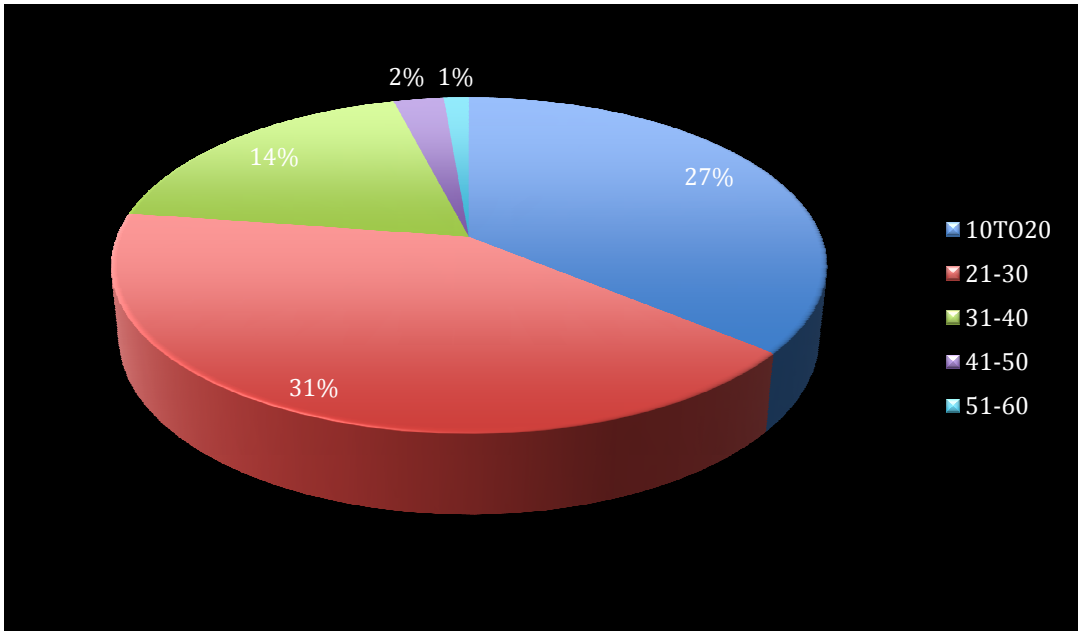
TABLE 11: DISTRIBUTION OF MALES AND FEMALES WITH TZANAKIS SCORE ≥8 (GROUP 1)

	10 -20	21-30	31-40	41-50	51-60	Total
Males	15	17	7	1	0	40
Females	12	14	7	1	1	35
Total	27	31	14	2	1	75

TABLE 12: DISTRIBUTION OF MALES AND FEMALES WITH TZANAKIS SCORE <8 (GROUP 2)

	10-20	21-30	31-40	41-50	51-60	Total
Males	5	8	0	1	0	14
Females	3	6	2	0	0	11
Total	8	14	2	1	0	25

CHART 5: AGE WISE DISTRIBUTION OF NEW SCORE



Highest number of males and females were present in the age group between 21- 30 years in both the groups.

DISTRIBUTION OF CASES AS PER HISTOPATHOLOGICAL REPORT

In the present study (76%) cases had acute appendicitis on histopathological examination whereas (24%) had normal appendix on histopathological examination.

TABLE 13: DISTRIBUTION OF CASES AS PER HISTOPATHOLOGICAL REPORT

HPE POSITIVE	HPE NEGATIVE
76	24

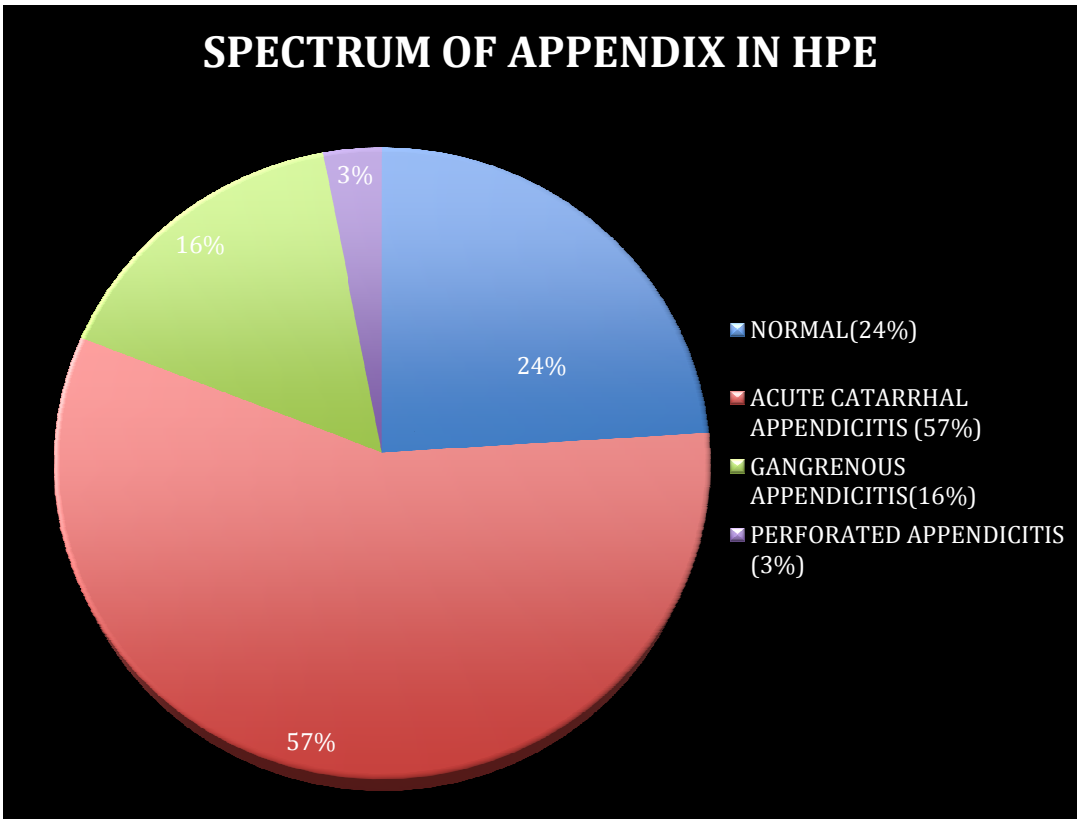
Out of the 80 cases, which had histopathological evidence of acute appendicitis, the reporting was as follows.

TABLE 14: PATHOLOGICAL DIAGNOSIS AS PER HISTOPATHOLOGICAL REPORT

HPE	Number	Percentage
Normal appendix	24	24%
Acute catarrhal	57	57%
Gangrenous	16	16%
Perforated	3	3%
Total	**100**	**100%**

The percentage of complicated appendicitis was 19%.

CHART 6: SPECTRUM OF APPENDIX IN HPE



EVALUATION OF THE ROLE OF ULTRASOUND IN DIAGNOSIS OF ACUTE APPENDICITIS BY CORRELATION WITH HPE REPORTS

TABLE 15: USG FINDINGS IN STUDY POPULATION

- In our study population 58% had positive findings in USG.
- Out of the 58% of patients, 56% had acute appendicitis on histopathological examination whereas HPE was negative in 2% of patients
- Association of USG findings with Histo-pathological findings was thus found to be statistically significant.

USG	Number	Percentage
Positive	58	58%
Negative	42	42%

CHART 7: USG FINDINGS IN HPE POSITIVE AND NEGATIVE CASES

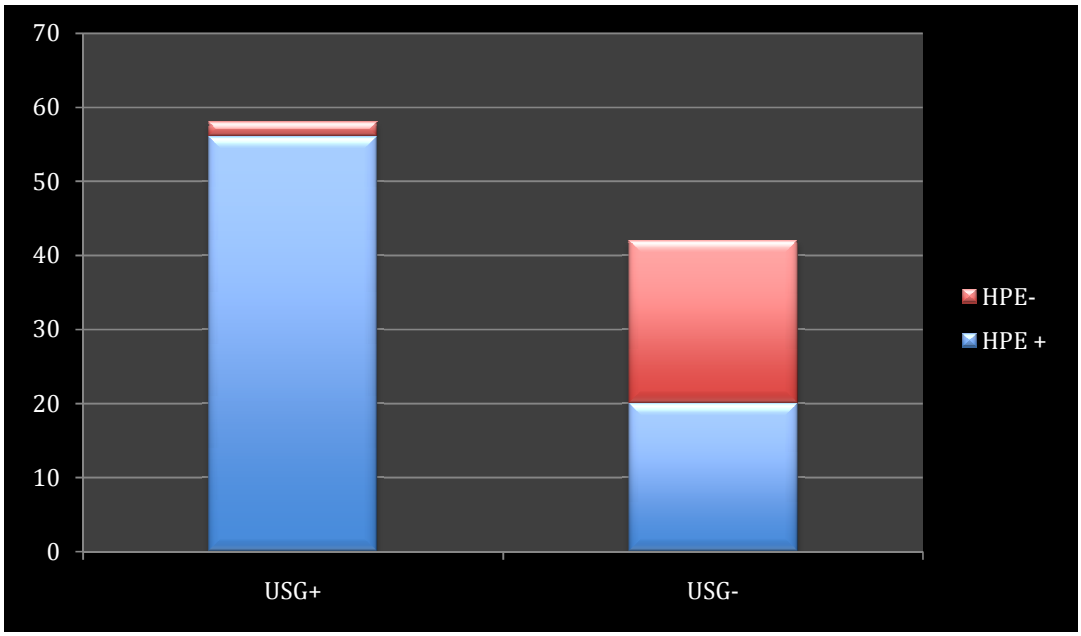


TABLE 16: USG IN HPE POSITIVE AND NEGATIVE CASES

USG	HPE Positive	HPE Negative	Chisquare value	P value
Positive	56(96.6%)	2(3.4%)	31.97	.000*
Negative	20(47.6%)	22(52.4%)		

*→ Significant

Association of USG findings with Histo-pathological findings was found to be statistically significant.

TABLE 17 : RESULTS

Sensitivity	73.7%
Specificity	91.7%
Positive predictive value	96.5%
Negative predictive value	55%

EVALUATION OF THE ROLE OF TOTAL LEUCOCYTE COUNT IN DIAGNOSIS OF ACUTE APPENDICITIS BY CORRELATION WITH HPE REPORTS

Total leucocyte count

- In our study population 51% of patients had leukocytosis.
- Among the patients with leukocytosis (51%), histopathological evidence of acute appendicitis was present in 45% of patients.
- Association between leukocytosis and HPE findings was found to be statistically significant.

TABLE 18: TOTAL LEUCOCYTE COUNT IN STUDY POPULATION

Total Leucocyte count	Number	Percentage
>12000	51	51%
<12000	49	49%

CHART 8: TOTAL LEUCOCYTE COUNT IN HPE POSITIVE AND NEGATIVE CASES

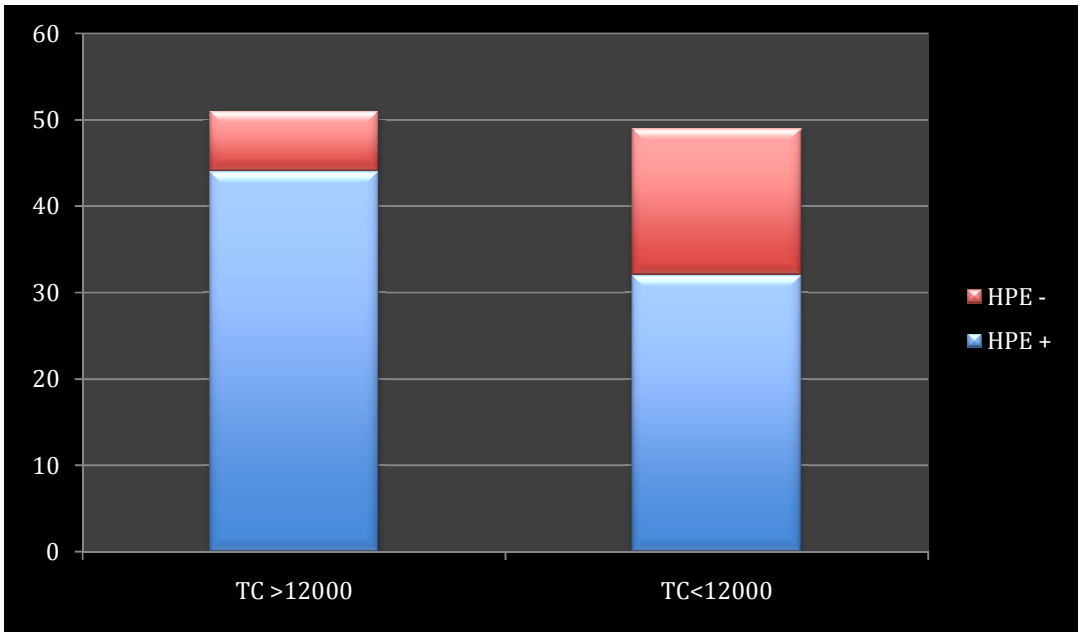


TABLE 19: TOTAL LEUCOCYTE COUNT IN HPE POSITIVE AND NEGATIVE CASES

Total Leucocyte count	HP Positive	HP Negative	Chisquare value	P value
>12000	45(88.2%)	6(11.8%)	8.542	.003*
<12000	31(63.3%)	18(36.7%)		

*→ Significant

Association of Total leucocyte count with Histo-pathological findings was found to be statistically significant.

TABLE 20 : RESULTS

Sensitivity	59.2%
Specificity	75%
Positive predictive value	88.23%
Negative predictive value	36.7%

EVALUATION OF THE ROLE OF REBOUND TENDERNESS IN DIAGNOSIS OF ACUTE APPENDICITIS BY CORRELATION WITH HPE REPORTS

TABLE 21: REBOUND TENDERNESS IN STUDY POPULATION

- 72% of total study population had rebound tenderness of which HPE was positive in 60% of patients.
- Association between rebound tenderness and HPE findings was found to be statistically insignificant.

Rebound	Number	Percentage
Present	72	72%
Absent	28	28%

CHART 9: REBOUND TENDERNESS IN HPE POSITIVE AND NEGATIVE CASES

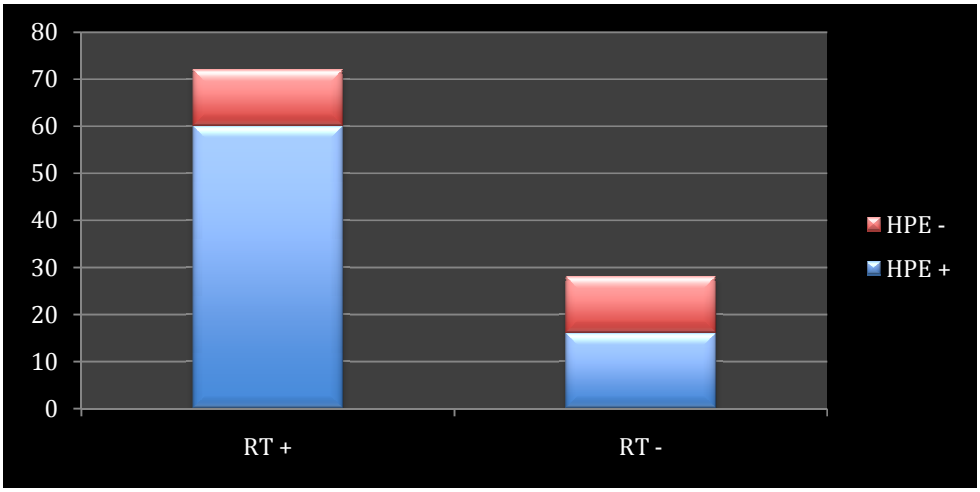


TABLE 22: REBOUND TENDERNESS IN HPE POSITIVE AND NEGATIVE CASES

Rebound tenderness	HPE Positive	HPE Negative	Chisquare value	P value
Positive	60(83.3%)	12(42.9%)	7.581	.006*
Negative	16(57.1%)	12(42.9%)		

*→Not Significant

Association of rebound tenderness with Histo-pathological findings was found to be statistically insignificant.

TABLE 23 :RESULTS

Sensitivity	78.94%
Specificity	50%
Positive predictive value	83.33%
Negative predictivevalue	42.86%

EVALUATION OF THE ROLE OF THE NEW SCORING SYSTEM IN DIAGNOSIS OF ACUTE APPENDICITIS BY CORRELATION WITH HPE REPORTS

TABLE 24: TZANAKI SCORE VS. HISTOPATHOLOGY

- Among the study population, 75% had a score more than 8 of which 71% had histological evidence of acute appendicitis.
- Acute appendicitis was significantly high in patients with new score ≥8.
- HPE was negative in 4% of patients who had score more than 8.
- Negative appendicectomy rate of the new score is 4%.
- Sensitivity and specificity of the new score is 93.4% and 83.3% respectively.

SCORE	HPE+	HPE-	TOTAL
≥8	71	4	75
<8	5	20	25
TOTAL	76	24	100

CHART 10:TZANAKIS SCORE IN HPE POSITIVE AND NEGATIVE CASES

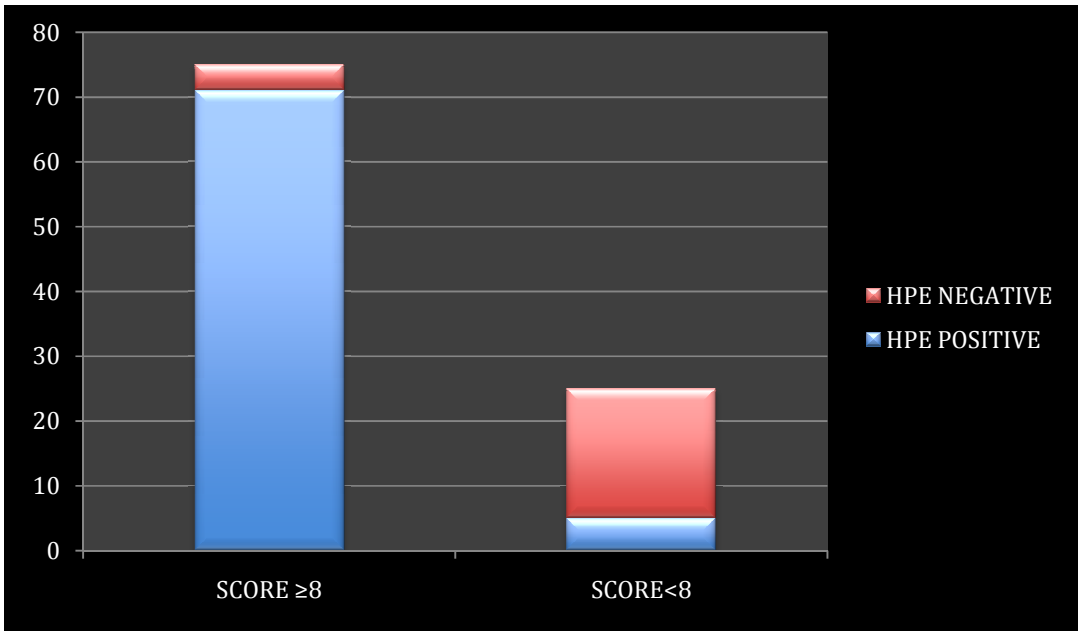


TABLE 25: TZANAKIS SCORE IN HPE POSITIVE AND NEGATIVE CASES

Score	HPE Positive	HPE Negative	Chisquare value	P value
≥8	71	4	57.310	.000*
<8	5	20		
Total	76	24		

*→ Significant

Association of new score with Histo-pathological findings was found to be statistically significant.

TABLE 26: RESULTS

Sensitivity	93.4%
Specificity	83.3%
Positive predictive value	94.6%
Negative predictive value	80%

DISCUSSION

One of the most commonly encountered emergencies in surgical field is acute appendicitis. Acute appendicitis has traditionally been a clinical diagnosis, which at times becomes difficult to diagnose due to complex presentation. Accurate and early diagnosis is of vital importance in reducing the occurrence of complications.

Inspite of the advances in imaging and newer methods of investigations diagnosis of acute appendicitis continues to be difficult. Besides clinical examination, various laboratory tests and imaging modalities are used to diagnose acute appendicitis accurately. However these techniques are not available universally.

Numerous scoring systems have been developed to diagnose acute appendicitis of which Alvarado scoring system is widely used. Nikolas E.Tzanakis and colleagues developed a new scoring system in 2004. This new system of scoring consists of only four parameters namely ultrasound examination, right lower quadrant tenderness, rebound tenderness and leukocytosis with a total score of 15. Score of 8 and above is taken as the cut-off value for acute appendicitis. The New scoring system has sensitivity of 95.4%, specificity of 97.4% and positive predictive value of 96.5%.

The present study was undertaken to evaluate the usefulness of this new scoring system in diagnosing acute appendicitis and its role in reducing the negative appendicectomy rate.

The present study consists of 100 patients, of which males accounted for 54% and females 46%. The number of patients was highest in the age group 21 to 30 years (45%) followed by 10 to 20 years. Most of the patients were in the younger age group. Among the four parameters of Tzanakis score right lower quadrant tenderness was present in all patients, USG findings were positive in 58%, rebound tenderness was present in 72% and leukocytosis was seen in 51% of patients.

Out of the 100 patients who were operated, 76% had acute appendicitis on histopathological examination and 24% had normal appendix. Among the 75 patients who had score of 8 and above, 71 patients had acute appendicitis on histopathological examination. The sensitivity and specificity of the new score is 93.4% and 83.3% respectively. The new scoring system has positive predictive value of 94.6% and negative appendicectomy rate of 4%. The association of new score with histopathological findings is statistically significant with p value (0.00). Among the four variables, the association of USG and leukocytosis with histopathological findings is statistically significant.

Series	Sensitivity	Specificity	Diagnostic accuracy
SigdelGs et al	91.48%	66.66%	90%
Zakur et al	95.4%	97.4%	96.5%
Present study	93.4%	83.3%	94.6%

On comparing with above two series present study also has consistent result. The usefulness of the New scoring system is demonstrated beyond doubt by reducing the rate of negative appendicectomies.

CONCLUSION

The new scoring system has high sensitivity and positive predictive value of 93.4% and 94.6% respectively. Application of new scoring system can reduce the negative appendectomy rate which is 4% in our study. The New scoring system is very effective in the diagnosis of acute appendicitis in both males and females. Good clinical judgement supported by investigation can help to diagnose acute appendicitis effectively. The New scoring system can be used as an effective modality to diagnose appendicitis.

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APPENDIX-I

PROFORMA

I. Basic Details:

Name of the patient:	
Age (in years) :	Sex: M / F
In patient Number :	Address:
Date of admission:	Date of discharge:

II. History:

i. Chief Complaints

ii. Duration

iii. History of present illness

iv. Past History

   a. History of Pulmonary Disease

   b. History of Diabetes

   c. History of Heart Disease

   d. History of previous surgeries

v. Personal History

   a. History of smoking / alcoholism

III. General Examination:

i. General survey:
ii. Body build and nourishment:
iii. Attitude: Restless/ Quiet
iv. Dehydration: Mild/ Moderate/ Severe/ Nil
v. Anaemia/Jaundice/Clubbing/Cyanosis/Lymphadenopathy/Pedal oedema
vi. Pulse:
vii. Temperature:
viii. Respiratory rate:
ix. Blood pressure:

IV. Examination of Abdomen:

i. Inspection
ii. Palpation
iii. Percussion
iv. Auscultation
v. Per Rectal Examination

V. Other System Examination:

i. Cardio vascular system
ii. Respiratory system

VI. Clinical Diagnosis:

VII. Investigations:

1. Blood: Hb %
2. TLC
3. DLC
4. BT
5. CT
6. Urine: Albumin/ Sugar/ Microscopy
7. Plain X-ray erect abdomen
8. Ultrasonography: Abdomen & Pelvis
9. Chest x-ray
10. Others

VIII.THE NEW SCORE

VARIABLES	POINTS
Positive USG for acute appendicitis	
Tenderness in right lower quadrant	
Rebound tenderness	
Leukocyte count>12000/ul	
Total score	

IX. MANAGEMENT

SURGICAL:

POST OP RECOVERY:

HISTOPATHOLOGY REPORT:

APPENDIX-II

INFORMED CONSENT

DEPARTMENT OF GENERAL SURGERY

Coimbatore Medical College, Coimbatore

I have been invited to participate in research project titled **"Evaluation Of A New Scoring System In The Preoperative Diagnosis Of Acute Appendicitis"**

I understand, it will be answering a set of questionnaire, undergo physical examination, investigations and appropriate treatment. I also give consent to utilize my personal details for study purpose and can be contacted if necessary. I am aware that I have the right to withdraw at any time which will not affect my medical care.

Name of the participant :

Signature :

Date :

APPENDIX-III

MASTER CHART

S.no	Patient's Name	IP no	Sex	Age	RLQ Tenderness	Rebound Tenderness	TLC	USG	New Score	P.D	HPR
1	Selvaraj	38977	M	19	Y	Y	12800	AA	15	AA	AA
2	Shanthi	37127	F	21	Y	N	13000	AA	12	AA	AA
3	Ravi	38912	M	17	Y	Y	14000	PT	9	AA	AA
4	Mahendran	31276	M	22	Y	Y	7800	PT	7	AA	NA
5	Gokul	47018	M	16	Y	N	13000	AA	12	AA	AA
6	Vasanthi	47068	F	38	Y	Y	14500	PT	9	AA	AA
7	Angamuthu	48435	M	32	Y	N	11500	AA	10	AA	GA
8	Damodharan	50128	M	28	Y	N	13200	AA	12	AA	GA
9	Akshaya	75479	F	20	Y	Y	13000	AA	15	AA	PA
10	Nasreen banu	75854	F	14	Y	N	10500	AA	10	AA	AA
11	Divya	66131	F	29	Y	Y	14000	PT	9	AA	AA
12	Anish	63560	M	25	Y	Y	8400	PT	7	AA	NA
13	Shamruth Banu	68921	F	25	Y	N	13200	AA	12	AA	AA
14	Ravi	86321	M	20	Y	Y	14000	PT	9	AA	AA
15	Mani	87947	M	16	Y	Y	10000	AA	13	AA	GA
16	Keerthana	96532	F	26	Y	Y	13000	PT	9	AA	AA
17	Selvi	89123	F	33	Y	Y	12900	AA	15	AA	GA
18	Nasrin	99871	F	39	Y	N	10800	AA	10	AA	AA
19	Karthick	86543	M	28	Y	Y	9100	PT	7	AA	AA
20	Shanthi	98172	F	25	Y	N	13600	AA	12	AA	AA
21	Natarajan	76892	M	19	Y	Y	13100	PT	9	AA	AA

22	Kannan	98134	M	30	Y	Y	13400	AA	15	AA	AA
23	Darshini	78147	F	22	Y	N	12600	AA	12	AA	AA
24	Sumitra	77142	F	19	Y	Y	12600	PT	9	AA	AA
25	Aruchamy	86549	M	27	Y	Y	12900	AA	15	AA	AA
26	Chandran	33194	M	29	Y	Y	11000	AA	13	AA	PA
27	Arumugam	96543	M	44	Y	Y	14500	AA	15	AA	AA
28	Vinoth kumar	16060	M	33	Y	Y	15700	AA	15	AA	GA
29	Rajendra	15739	M	20	Y	Y	5200	PT	7	AA	NA
30	Valli	15743	F	22	Y	Y	6900	PT	7	AA	NA
31	Kannan	15938	M	28	Y	Y	12400	AA	15	AA	AA
32	Kalyani	16015	F	25	Y	Y	15100	AA	15	AA	AA
33	Ganga	15685	F	20	Y	Y	13600	PT	9	AA	AA
34	Neema rose	12334	F	21	Y	N	8900	PT	4	AA	NA
35	Sarath kumar	5754	M	29	Y	Y	14300	AA	15	AA	AA
36	Rajee	82771	F	25	Y	Y	10500	AA	13	AA	AA
37	Sita	23010	F	33	Y	Y	9100	AA	13	AA	AA
38	Selvaraj	16578	M	40	Y	Y	12800	AA	15	AA	AA
39	Latha	22109	F	19	Y	N	9100	PT	4	AA	NA
40	Amirtham	22789	F	27	Y	Y	12700	AA	15	AA	AA
41	Rukmani	17890	F	25	Y	Y	9500	PT	7	AA	GA
42	Manickam	32011	M	29	Y	N	13200	PT	6	AA	AA
43	Eswari	24780	F	20	Y	Y	14000	AA	15	AA	AA
44	Haldurai	16878	M	33	Y	N	13600	AA	12	AA	AA
45	Maniyal	99100	F	35	Y	Y	6900	AA	13	AA	NA
46	Dharmaraj	17568	M	20	Y	Y	13100	PT	9	AA	AA
47	Pushpa	21078	F	19	Y	Y	8900	AA	13	AA	GA
48	Senthil	18902	M	32	Y	Y	13800	PT	9	AA	AA
49	Gayathri	22890	F	34	Y	N	7700	AA	10	AA	AA

50	Mayilal	20567	F	45	Y	Y	9100	AA	13	AA	AA
51	Velu	19356	M	20	Y	Y	12900	AA	15	AA	GA
52	Kasiammal	32890	F	19	Y	Y	13150	PT	9	AA	AA
53	Kanchana	45278	F	29	Y	Y	5700	AA	13	AA	AA
54	Dhandapani	78290	M	25	Y	Y	6500	AA	13	AA	GA
55	Jothimani	62572	F	30	Y	N	13050	AA	12	AA	AA
56	Ravi	24109	M	27	Y	Y	9200	PT	7	AA	NA
57	Sundarraj	72899	M	20	Y	Y	13400	AA	15	AA	PA
58	Yesodha	26891	F	19	Y	N	7900	AA	10	AA	NA
59	Shanthi	38720	F	18	Y	Y	8800	AA	13	AA	GA
60	Gunasekaran	68392	M	20	Y	Y	5200	PT	7	AA	AA
61	Mahalakshmi	26821	F	26	Y	N	7700	PT	4	AA	NA
62	Jaibunisha	72982	F	30	Y	Y	12900	AA	15	AA	AA
63	Sekar	27199	M	15	Y	N	13100	PT	6	AA	AA
64	Jhansi	27386	F	19	Y	Y	7800	AA	13	AA	GA
65	Hakkim	36812	M	22	Y	Y	10200	AA	13	AA	AA
66	Santhosh	26729	M	29	Y	Y	12200	PT	9	AA	AA
67	Radhakrishnan	27691	M	26	Y	Y	12800	AA	15	AA	AA
68	Manju	63881	F	24	Y	Y	7300	AA	13	AA	GA
69	Muthupandi	27270	M	22	Y	Y	13300	AA	15	AA	AA
70	Selvaraj	25427	M	21	Y	N	8900	AA	10	AA	AA
71	Poonkodi	63892	F	20	Y	N	12600	PT	6	AA	NA
72	Diwakar	96167	M	15	Y	Y	9600	AA	13	AA	AA
73	Dinesh	75182	M	19	Y	Y	12850	AA	15	AA	GA
74	Rathinam	27129	M	26	Y	Y	13450	AA	15	AA	AA
75	Subbulaxmi	15427	F	52	Y	Y	14200	PT	9	AA	AA
76	Mani	42718	M	33	Y	Y	13650	PT	9	AA	AA
77	Meena	68926	F	17	Y	Y	9300	PT	7	AA	NA
78	Sakthi	98729	M	22	Y	Y	4500	AA	13	AA	AA

79	Radha	42679	F	16	Y	N	7800	AA	10	AA	AA
80	Lalbaghadur	42781	M	29	Y	Y	13100	PT	9	AA	NA
81	Karuppan	47268	M	24	Y	N	13600	PT	6	AA	NA
82	Neelakandan	28791	M	32	Y	Y	10500	AA	13	AA	AA
83	Manoharan	77169	M	18	Y	N	9800	PT	4	AA	NA
84	Kavya	25681	F	24	Y	Y	7600	PT	7	AA	NA
85	Thamaraikannan	76268	M	16	Y	Y	10200	AA	13	AA	AA
86	Vidya	61681	F	28	Y	N	11500	PT	4	AA	NA
87	Ramesh	71811	M	24	Y	Y	8700	AA	13	AA	GA
88	Prakash	26581	M	18	Y	N	13900	PT	6	AA	NA
89	Jayanthi	26891	F	35	Y	Y	10700	AA	13	AA	GA
90	Harish	89629	M	19	Y	Y	12500	PT	9	AA	AA
91	Mallika	57729	F	37	Y	Y	11700	PT	7	AA	NA
92	Manohar	79269	M	42	Y	N	10900	PT	4	AA	NA
93	Devi	62988	F	20	Y	Y	7900	AA	13	AA	GA
94	Tharani	41816	F	26	Y	Y	13100	PT	9	AA	NA
95	Kumar	38215	M	29	Y	N	13400	PT	6	AA	NA
96	Giri	62862	M	24	Y	Y	9900	AA	13	AA	AA
97	Porkodi	88282	F	32	Y	N	7500	PT	4	AA	NA
98	Mani	42628	M	20	Y	Y	6400	AA	13	AA	AA
99	Jayakumar	26836	M	19	Y	Y	9700	AA	13	AA	AA
100	Karthi	26282	M	29	Y	Y	7000	PT	7	AA	NA

KEY TO MASTER CHART

S. no	Serial number
Ip. No	In patient number
M	Male
F	Female
RLQ	Right lower quadrant
Y	Yes
N	No
TLC	Total Leucocyte Count
USG	Ultrasonography
AA	Acute appendicitis
PT	Probe tenderness
P. D	Provisional Diagnosis
HPR	Histopathological Report
NA	Normal appendix
GA	Gangrenous appendix
PA	Perforated appendix